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ABSTRACT

In a study of infant smiling, 20 mother-infant dyads were videotaped in normal face-to-face interaction when the infants were 9 and 14 weeks of age. Videotapes were used to determine which of two classes of smiling behavior models, either arousal modulation or activation indicator, was most supported by empirical data. Arousal modulation models view the infant's smile as a component of a process of modulation reducing cognitive arousal to moderate levels. Activation indicator models, such as the Interaction Task Model, view the smile as an indication that the infant's arousal, activation, or energy levels are rising, either as a result of stimulation or in anticipation of increased cognitive or physical activity. At each data-gathering point, 1 hour of usable interaction was obtained from each dyad, in which the infant was alert and content. Onsets and offsets of smiling, looking, and vocalizing in both infant and mother were coded for time-lagged conditional probability analysis. A set of 11 opposing predictions was established to contrast the models. Opposite conditional probability relationships were predicted in 6 cases, and opposite age differences in conditional relationships were predicted in 5 cases. Reported findings were consistent with the activation indicator models. It is concluded that the Interaction Task Model furthers understanding of early infant social behavior. Numerous line graphs are provided. (RH)

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INFANT SMILING DURING SOCIAL INTERACTION: AROUSAL MODULATION OR ACTIVATION INDICATOR?[1]

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Parent-infant interaction during the first few months of life is heavily punctuated by smiling. For many years, theorists have speculated about the role which these smiles have for the infant. Currently, models tie the smile to the loosely defined construct labelled "cognitive arousal," "activation," or "tension," either as a contributor or indicator variable. Differences between models relate primarily to the nature of the smile-arousal relationship. While the notion of cognitive arousal is a valuable organizing construct for models of infant behavior and development, no definitive studies have established the exact manner in which smiles are related to this arousal. This report contrasts two opposing types of model. In one type, smiles occur as or after arousal is modulated. In the other, smiles occur as arousal is rising, as the infant experiences short-term increases in cognitive activation.

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AROUSAL MODULATION MODELS

Several models (Sroufe and Waters, 1976; Field, 1981; Fogel,

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1. Ewy, R. (1986, April). Paper presented at the International Conference on Infant Studies. Los Angeles.

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1982; Sroufe, 1984) are based in part on the cognitive mechanism of smiling as a result of recognitory assimilation (Piaget, 1952, p. 71-74), pleasure at recognizing an object as familiar.[2] This set of models includes the "Tension Release Mechanism" of Sroufe and Waters (1976; Sroufe, 1984), The "Optimal Band of Activation Model" of Field (1981), and the "Affective Tolerance Model" of Fogel (1982). These models suggest that smiling occurs after effortful assimilation. Arousal increases as the infant attempts to assimilate or cope with the stimulation, and the smile is a component of a process of modulation which brings cognitive arousal back down to moderate levels. Developmentally, there would be an increase in the ability to maintain orientation toward higher levels of cognitive stimulation, or to tolerate the higher cognitive tension which is engendered. There would be an increase in the association between the smile and arousal modulation, reducing the need to fall back on gaze aversion.

These models are attractive in that they stress the intrapsychic, cognitive role of arousal, but they undervalue the influence of the interpsychic, social-cognitive roles played by the smile. The addition of this aspect will improve our understanding of early social interaction and its development.

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2. This mechanism was later modified to suggest that smiling was a result of assimilative mastery (Piaget, 1962, p. 89-92; Shultz & Zigler, 1970), pleasure at being able to assimilate a perceptual object, a change which may be significant enough to be problematic for these models.

ACTIVATION INDICATOR MODEL

In models of this type, the smile is taken to indicate that the infant's arousal, activation, or energy levels are rising, either as a result of stimulation or in anticipation of increased cognitive (or physical) activity.

Interaction Task Model. The infant must perform several tasks when interacting. Among these are attending to and processing social stimulation, and organizing and producing social responses. The smile is one of these social behaviors. It communicates information about psychic status. Mothers typically take it to indicate that her baby has increased his attentiveness or involvement in the interaction. Following an infant smile, mother usually increases her stimulation of the infant. The Interaction Task Model incorporates this communicative function, and the consequences it holds for stimulation. The smile is viewed as reflecting a short-term rise in cognitive activation, which is designed to meet the increased cognitive processing demands that are a result of this social response.

Developmental aspects. The younger infant is less able to generate the arousal necessary for performing the tasks of interaction, which in sum are an energy expensive undertaking (Ewy, 1985, details the reasoning for this). In opposition to the arousal modulation models, the Interaction Task Model

suggests, that young infants turn away from social stimulation (or become distressed) not because arousal has exceeded tolerable limits, but because the current arousal level is too low to meet the energy demands of cognitive tasks which the interaction has placed in motion. Excessive arousal will also cause an infant to look away, but excessive levels are reached much less frequently than is suggested by the other models, especially at younger ages. Smiles occur more frequently in older infants because the increase in efficiency of arousal generating mechanisms produces faster, steeper rises in arousal. Infants smile not because they have controlled excessive tension, but because there is a sudden increase in processing capacity designed to meet rising demands.

METHOD

A set of 11 opposing predictions was established to contrast the models. Opposite conditional probability relationships were predicted in 6 cases, and opposite age differences in conditional relationships were predicted in 5 cases. Relationships for which models made similar predictions are not discussed here. For these, see Ewy (1985).

Mother and infant dyads (n=20) were videotaped at 9 weeks and at 14 weeks of age in normal face-to-face interaction. At each age, 1 hour (split over 4-12 taping sessions) of usable interaction was obtained, in which the infant was alert and content. Onsets and offsets of smiling, looking, and vocalizing

of both infant and mother were coded from the tapes for time-lagged conditional probability analysis.

RESULTS

In the following paragraphs, the condition-setting event is listed first, followed by an arrow (-->), and then the conditional event. In the figures, the condition-setting events occur at time 0, and the lags map the resulting changes in the probability of the conditional event.

1. Infant Start Look to Mother --> Infant End Look. All models predict a rise in Infant End Look above chance levels. Modulation models predict greater effect at 2 months (immature modulation, low tolerance). The activation model predicts the effect to be greater for 3 month olds (more efficient arousal mechanisms cause steeper rises, necessitating brief lookaways). Significant age differences (see curves in figure 1) favor activation model.
2. Infant End Look --> Infant Vocalize. Modulation models: End Look indicates arousal has been too high, and the infant needs to calm down, so the prediction is for fewer vocalizations. Activation model: End Looks sometimes occur when arousal is being diverted from perceptual tasks to production tasks, so a rise in probability of vocalization is predicted. Results (figure 2) favor activation model at 2

months. The age difference was predicted by that model.

3. Infant Smile --> Infant End Look. Strongest test between models. Modulation: When infants smile, arousal is modulated, so there should be less need to look away. Activation: Smile indicates rising arousal, which occasionally rises too far, increasing the need to avert gaze. Results (figure 3) favor activation model.
4. Infant End Smile --> Infant End Look. Similar to above. Modulation: Arousal has been modulated. Less need to look away. Activation: Arousal is rising, smile stops, infant averts gaze. Results (figure 4) favor activation model.
5. Mother Look --> Infant End Look. Opposing age predictions. Modulation: Older infants have reduced need to modulate arousal produced by the rise in stimulation. Activation: More efficient arousal means older infants have more need to avert gaze. Results (figure 5) indicate drop in probability of Infant End Look. All models need additional work. Counts as a tie.
6. Mother Look --> Infant Vocalize. Modulation: With moderate increases in arousal, infants should be able to vocalize more. Activation: The newly started perceptual tasks rob energy from production tasks, so fewer vocalizations should occur. Results (figure 6) favor activation model.
7. Mother Look --> Infant Smile. Modulation: Arousal increases, and smiles should accompany modulation. Activation: Newly

started tasks cause a fall in energy, which means fewer smiles. Results (figure 7) favor the activation model at 2 months. The age difference was predicted by that model.

8. Mother Smile --> Infant End Look. Age Difference. Modulation: 2 month olds have narrower band of tolerable arousal, so need to modulate will be greater. Activation: 3 month olds have more efficient arousal generator, so older infants have greater need to modulate arousal. Significant age differences (see curves in figure 8) favor activation model.

9. Mother Smile --> Infant Vocalize. Age difference. Modulation: Younger infants rely more on external stimulation for arousal, so 2 month olds will exhibit stronger contingency. Activation: 3 month olds' greater efficiency means a stronger responsiveness, which means higher conditional relationship. There were no age differences in terms of deviations from chance (see figure 9), so this comparison counts as a tie.

10. Infant Vocalize --> Mother Smile. Age difference. Modulation: Non-distress vocalizations should occur more frequently inside the optimal band. If mother is (unconsciously) aware that older infants have a wider optimal band, she should increase stimulation more for older infants. Activation: Younger infants are drained more by vocalizing. Mothers should use their smiles as arousing mechanisms more for the 2 month olds. Significant age

differences (see curves in figure 10) favor activation model.

11. Infant Smile --> Mother End Look. Modulation: Mothers may assist arousal modulation by briefly reducing the level of stimulation. This means more leaning away (not coded) and perhaps more looking away. Activation: Smile indicates rising arousal, so mothers can keep or increase the level of stimulation. Fewer lookaways. Results (figure 11) indicate fewer lookaways as predicted by the activation model.

Conclusions

The pattern of relationships reported is consistent with the proposed model in which smiles indicate that activation or arousal is rising, not being modulated. The smile happens during times of rising arousal, cognitive activation, or involvement in an interaction. In the first quarter year of life, the generation of arousal becomes more efficient, so 3 month olds have greater, not lesser, need than 2 month olds to modulate arousal. It is as if their "optimal band" of stimulation actually shrinks across this age span. The younger infants have less available arousal, so there are more behavioral manifestations of energy-shifting between the tasks of interaction. The Interaction Task Model improves our understanding of early infant social behavior.

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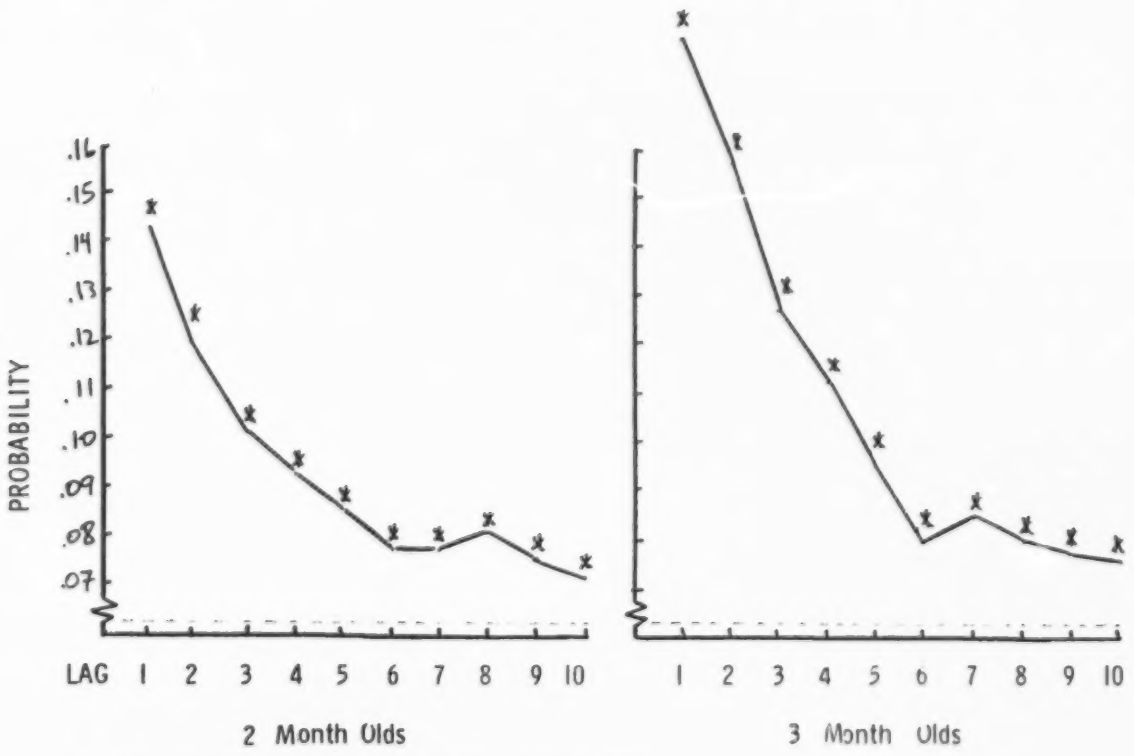
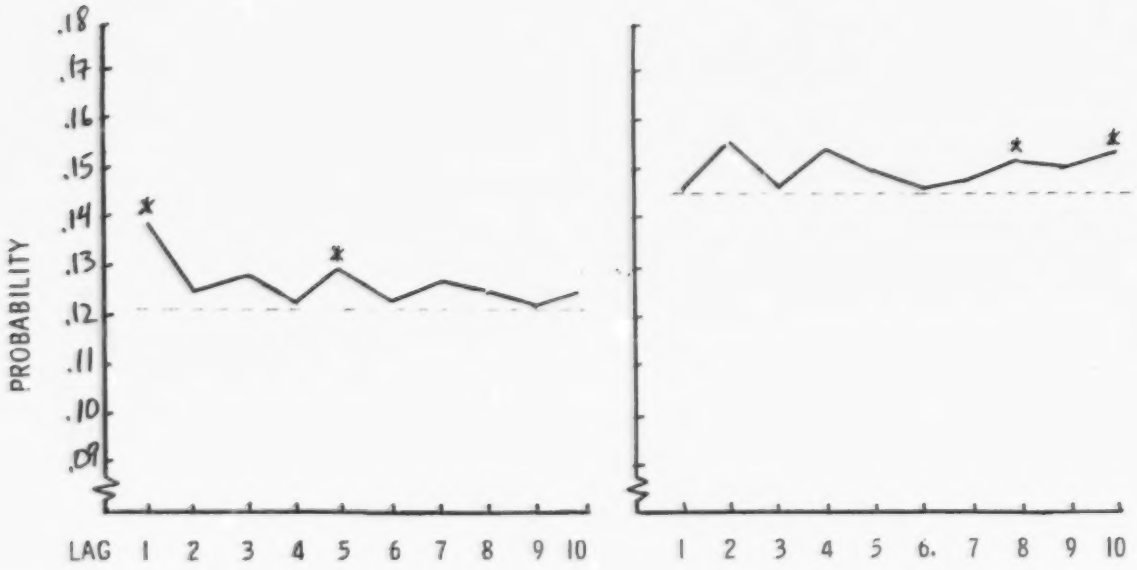
Note: The dashed lines on the figures represent chance (random) expectancies. Asterisks (*) indicate significant ($p < 0.05$) deviation from chance.



Anchor (Condition-setting event): Infant Look

Target (Conditional event): Infant End Look

Figure 1



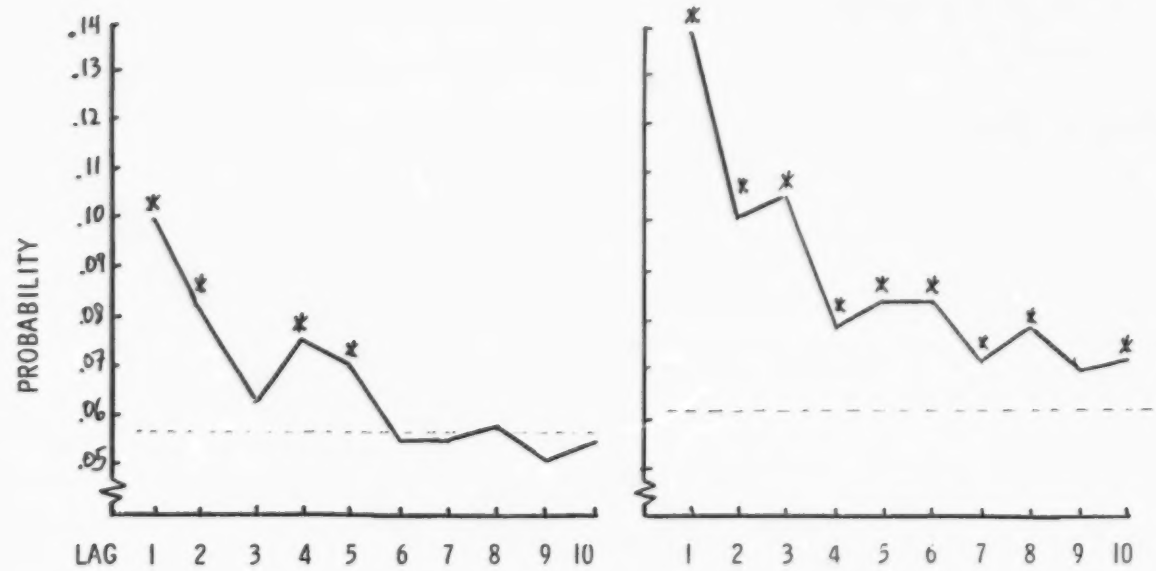
2 Month Olds

3 Month Olds

Anchor (Condition-setting event): Infant End Look

Target (Conditional event): Infant Vocalize

Figure 2



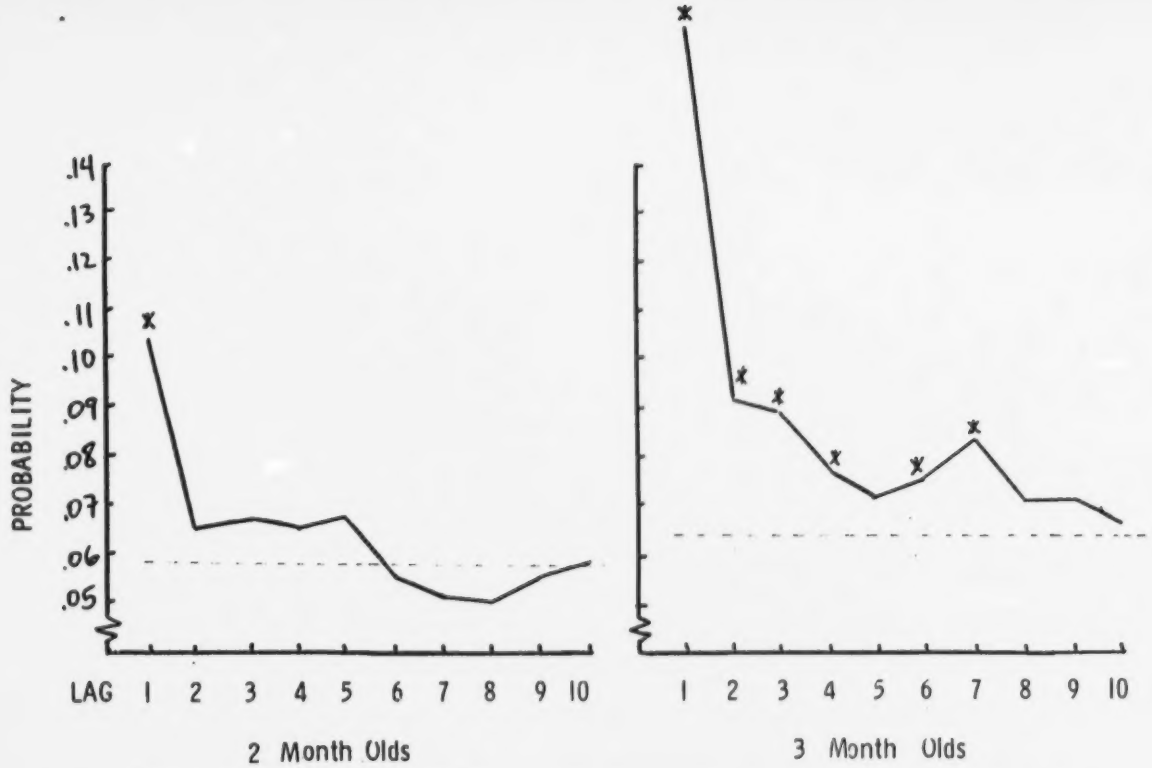
2 Month Olds

3 Month Olds

Anchor (Condition-setting event): Infant Smile

Target (Conditional event): Infant End Look

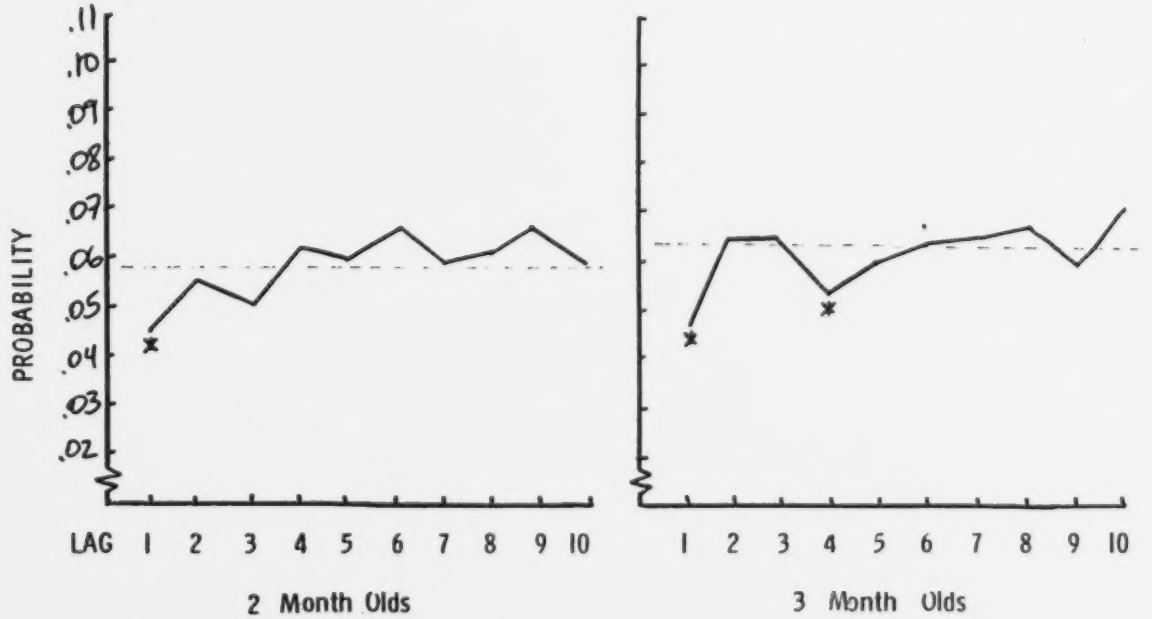
Figure 3



Anchor (Condition-setting event): Infant End Smile

Target (Conditional event): Infant End Look

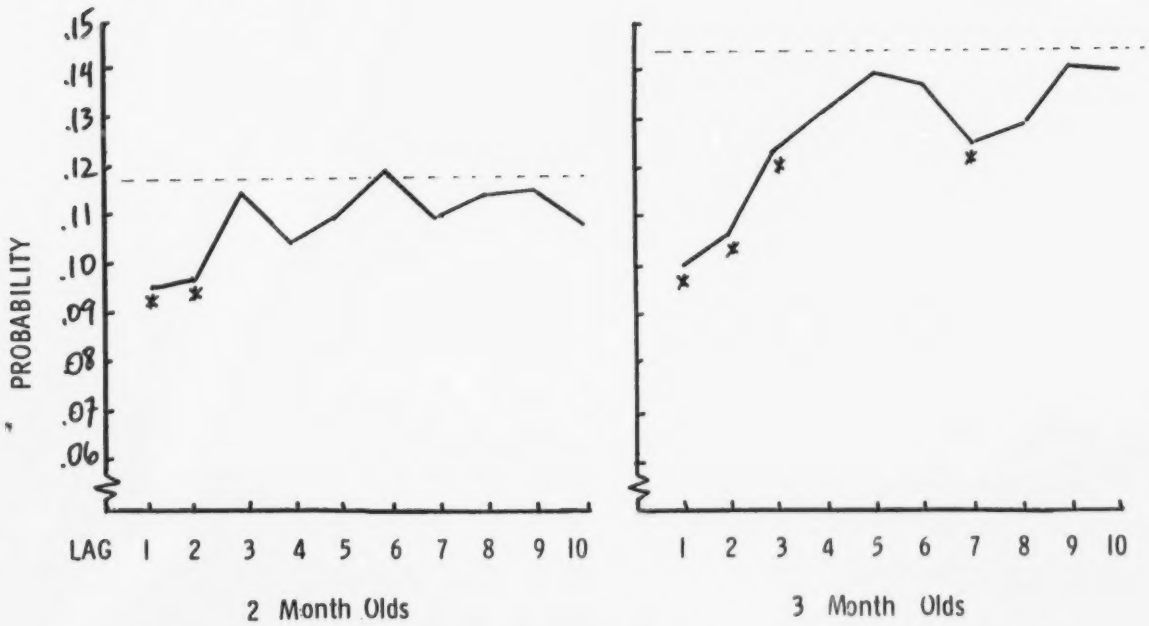
Figure 4



Anchor (Condition-setting event): Mother Look

Target (Conditional event): Infant End Look

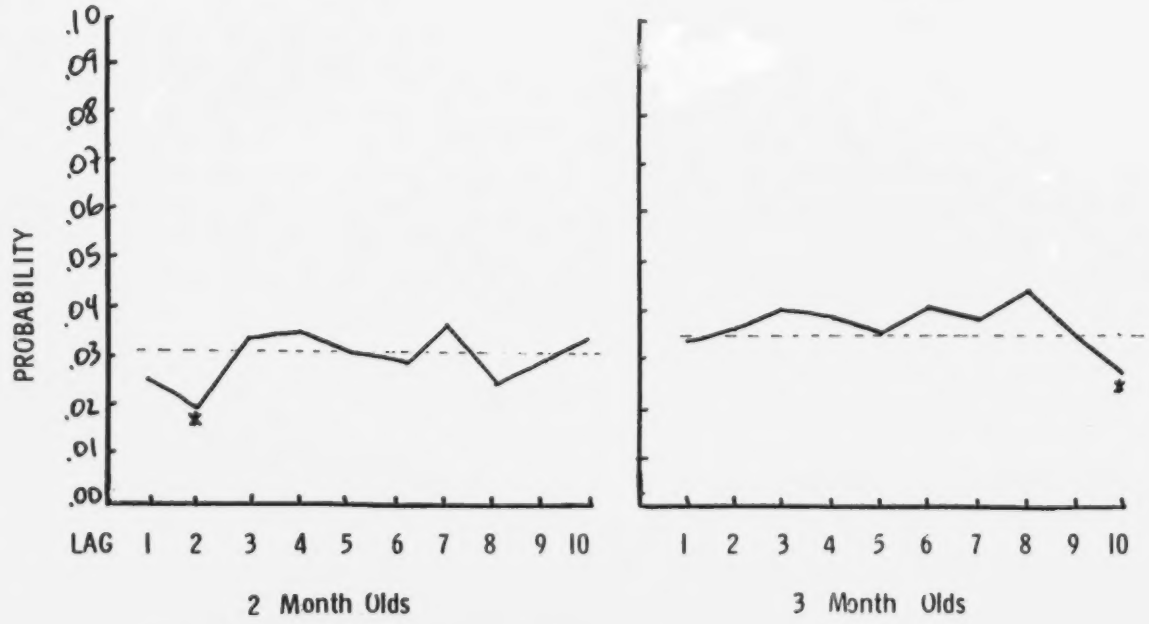
Figure 5



Anchor (Condition-setting event): Mother Look

Target (Conditional event): Infant Vocalize

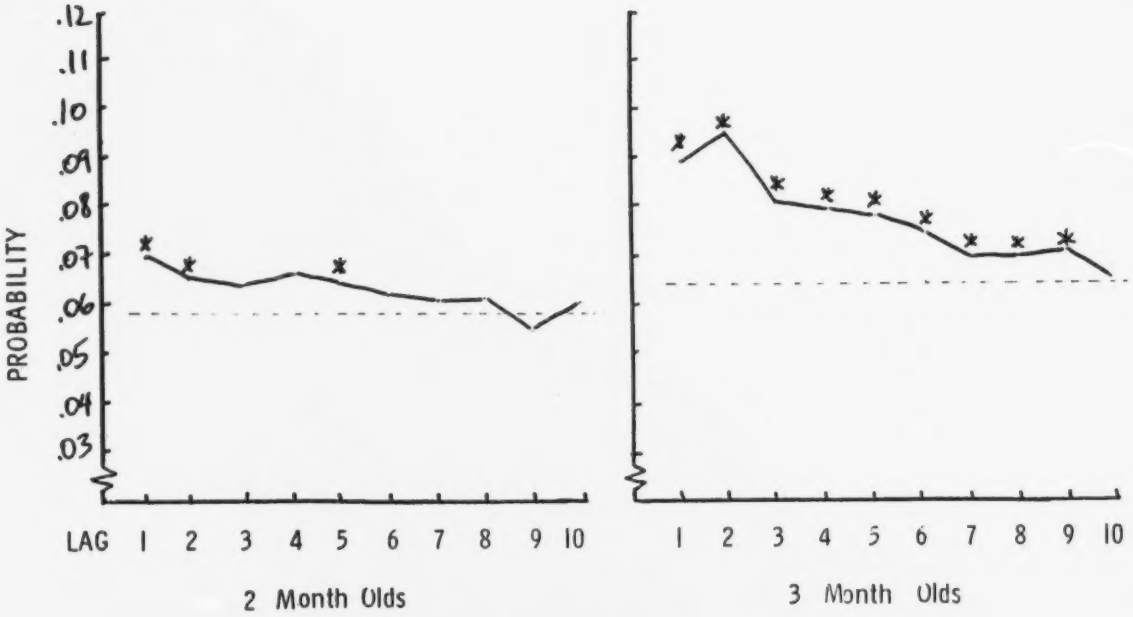
Figure 6



Anchor (Condition-setting event): Mother Look

Target (Conditional event): Infant Smile

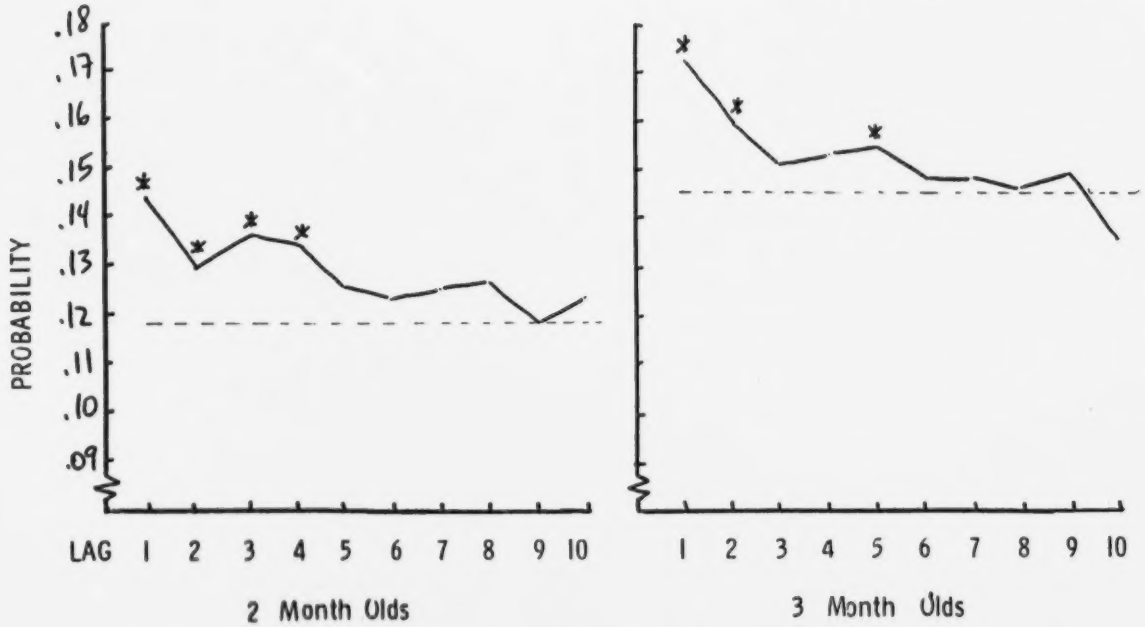
Figure 7



Anchor (Condition-setting event): Mother Smile

Target (Conditional event): Infant End Look

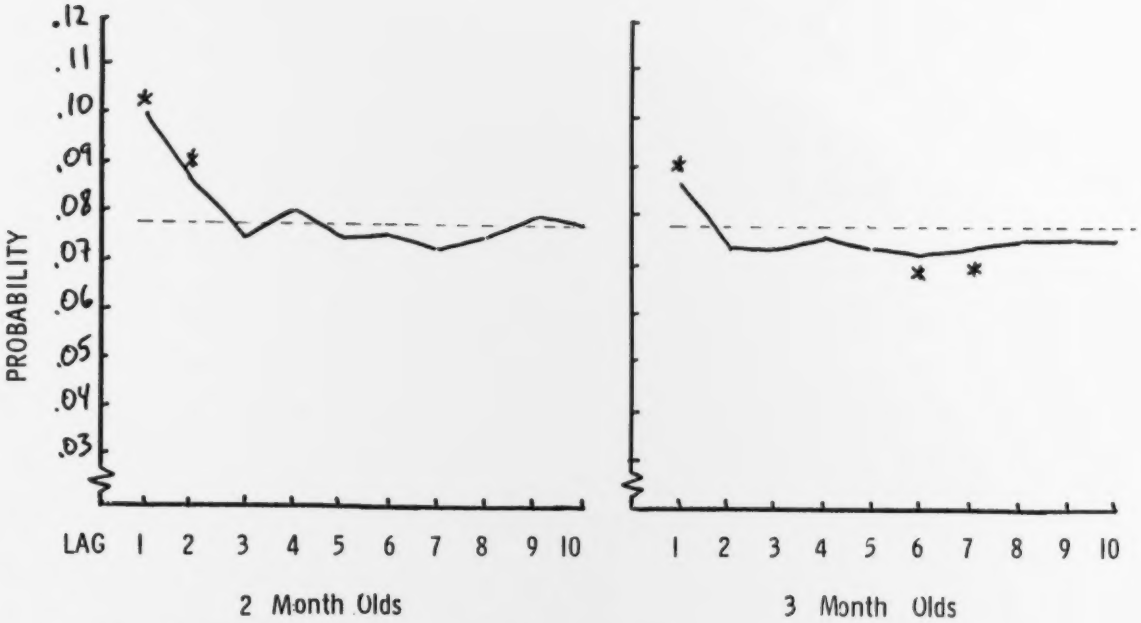
Figure 8



Anchor (Condition-setting event): Mother Smile

Target (Conditional event): Infant Vocalize

Figure 9

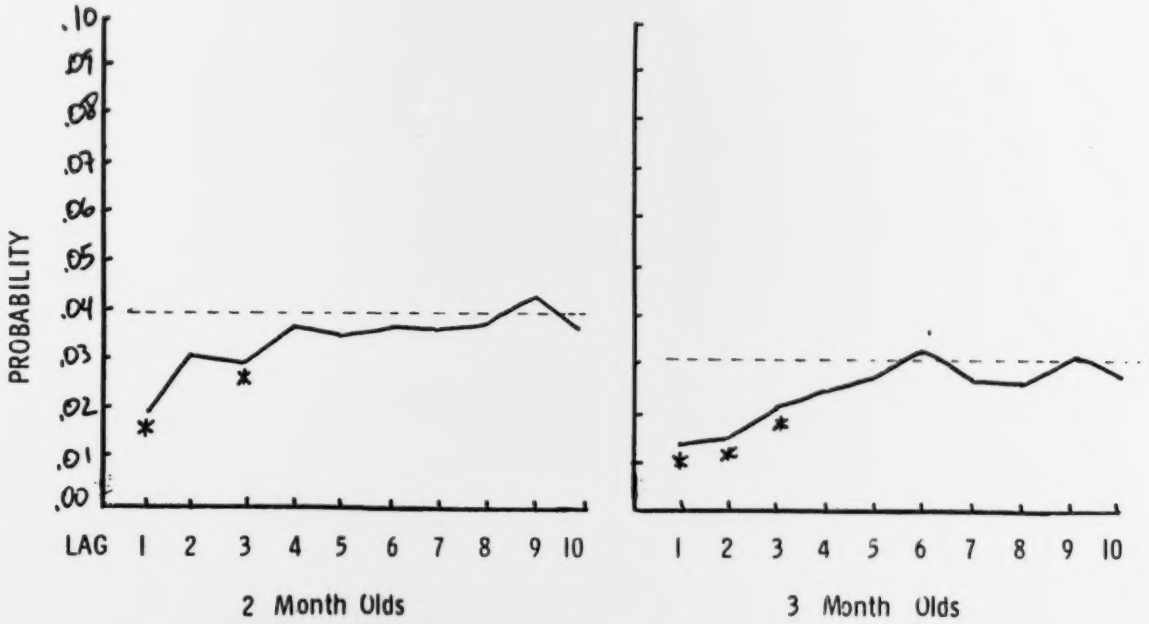


2 Month Olds 3 Month Olds

Anchor (Condition-setting event): Infant Vocalize

Target (Conditional event): Mother Smile

Figure 10



2 Month Olds 3 Month Olds

Anchor (Condition-setting event): Infant Smile

Target (Conditional event): Mother End Look